

PCT  
PATENT COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING  
OF A CHANGE(PCT Rule 92bis.1 and  
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

MODIANO, Guido  
Modiano & Associati  
Via Meravigli, 16  
I-20123 Milano  
ITALIE

<b>Date of mailing</b> (day/month/year) 30 July 1998 (30.07.98)	<b>IMPORTANT NOTIFICATION</b>
<b>Applicant's or agent's file reference</b> 30510/GM/ch	
<b>International application No.</b> PCT/EP97/06619	<b>International filing date</b> (day/month/year) 27 November 1997 (27.11.97)

## 1. The following indications appeared on record concerning:

☒ the applicant      ☐ the inventor      ☐ the agent      ☐ the common representative

## Name and Address

LINDGREN, Jimmy  
Merikatu 1B  
FIN-00140 Helsinki  
Finland

## State of Nationality

FI

## State of Residence

FI

Telephone No.

Facsimile No.

Teleprinter No.

## 2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☒ the person      ☒ the name      ☒ the address      ☒ the nationality      ☒ the residence

## Name and Address

TRANSCENDENTAL MEDITATION  
FOUNDATION  
Aeulestrasse 38  
9490 Vaduz  
Liechtenstein

## State of Nationality

LI

## State of Residence

LI

Telephone No.

Facsimile No.

Teleprinter No.

## 3. Further observations, if necessary:

## 4. A copy of this notification has been sent to:

☒ the receiving Office      ☐ the designated Offices concerned  
☐ the International Searching Authority      ☒ the elected Offices concerned  
☒ the International Preliminary Examining Authority      ☐ other:
The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

S. De Michiel

Telephone No.: (41-22) 338.83.38

## PATENT COOPERATION TREATY

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

United States Patent and Trademark  
Office  
(Box PCT)  
Crystal Plaza 2  
Washington, DC 20231  
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

<b>Date of mailing</b> (day/month/year) 15 July 1998 (15.07.98)	
<b>International application No.</b> PCT/EP97/06619	<b>Applicant's or agent's file reference</b> 30510/GM/ch
<b>International filing date</b> (day/month/year) 27 November 1997 (27.11.97)	<b>Priority date</b> (day/month/year) 02 December 1996 (02.12.96)
<b>Applicant</b> LINDGREN, Jimmy et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:  
29 June 1998 (29.06.98)

☐ in a notice effecting later election filed with the International Bureau on:  
\_\_\_\_\_

2. The election ☒ was  
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

<p>The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland</p> <p>Facsimile No.: (41-22) 740.14.35</p>	<p>Authorized officer C. Cupello</p> <p>Telephone No.: (41-22) 338.83.38</p>
--	--

## PCT INTERNATIONAL COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING  
OF A CHANGE(PCT Rule 92bis.1 and  
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

MODIANO, Guido  
Modiano & Associati  
Via Meravigli, 16  
I-20123 Milano  
ITALIE

<b>Date of mailing</b> (day/month/year) 02 July 1998 (02.07.98)	<b>IMPORTANT NOTIFICATION</b>
<b>Applicant's or agent's file reference</b> 30510/GM/ch	
<b>International application No.</b> PCT/EP97/06619	<b>International filing date</b> (day/month/year) 27 November 1997 (27.11.97)

## 1. The following indications appeared on record concerning:

☒ the applicant      ☐ the inventor      ☐ the agent      ☐ the common representative

<b>Name and Address</b> URETEK S.R.L. Via del Mercato, 12 I-37021 Bosco Chiesanuova Italy	<b>State of Nationality</b> IT	<b>State of Residence</b> IT
	<b>Telephone No.</b>	
	<b>Facsimile No.</b>	
	<b>Teleprinter No.</b>	

## 2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☒ the person      ☐ the name      ☐ the address      ☐ the nationality      ☐ the residence

<b>Name and Address</b> LINDGREN, Jimmy Merikatu 1B FIN-00140 Helsinki Finland	<b>State of Nationality</b> FI	<b>State of Residence</b> FI
	<b>Telephone No.</b>	
	<b>Facsimile No.</b>	
	<b>Teleprinter No.</b>	

## 3. Further observations, if necessary:

**This International Application has been assigned to LINDGREN, Jimmy with the exception of AT, FR, IT, PT, ES, CH and LI, MC, BA, YU, MK and SI.**

## 4. A copy of this notification has been sent to:

<input checked="" type="checkbox"/> the receiving Office	<input checked="" type="checkbox"/> the designated Offices concerned
<input type="checkbox"/> the International Searching Authority	<input type="checkbox"/> the elected Offices concerned
<input type="checkbox"/> the International Preliminary Examining Authority	<input type="checkbox"/> other:

<b>The International Bureau of WIPO</b> 34, chemin des Colombettes 1211 Geneva 20, Switzerland	<b>Authorized officer</b>  S. De Michiel
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

## PCT COOPERATION TREATY

(17)

PCT

From the INTERNATIONAL BUREAU

NOTIFICATION OF THE RECORDING  
OF A CHANGE(PCT Rule 92bis.1 and  
Administrative Instructions, Section 422)

To:

MODIANO, Guido  
Modiano & Associati  
Via Meravigli, 16  
I-20123 Milano  
ITALIE

Date of mailing (day/month/year) 30 July 1998 (30.07.98)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference 30510/GM/ch	
International application No. PCT/EP97/06619	International filing date (day/month/year) 27 November 1997 (27.11.97)

## 1. The following indications appeared on record concerning:

☒ the applicant      ☐ the inventor      ☐ the agent      ☐ the common representative

Name and Address LINDGREN, Jimmy Merikatu 18 FIN-00140 Helsinki Finland	State of Nationality FI	State of Residence FI
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

## 2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☒ the person      ☒ the name      ☒ the address      ☒ the nationality      ☒ the residence

Name and Address TRANSCENDENTAL MEDITATION FOUNDATION Aeulestrasse 38 9490 Vaduz Liechtenstein	State of Nationality LI	State of Residence LI
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	

## 3. Further observations, if necessary:

## 4. A copy of this notification has been sent to:

☒ the receiving Office      ☐ the designated Offices concerned  
☐ the International Searching Authority      ☒ the elected Offices concerned  
☒ the International Preliminary Examining Authority      ☐ other:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer S. De Michiel Telephone No.: (41-22) 338.83.38
---	---

From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

Modiano, Guido  
MODIANO & ASSOCIATI  
Via Meravigli, 16  
I-20123 Milano  
ITALIE

PCT

WRITTEN OPINION

(PCT Rule 66)

Date of mailing  
(day/month/year)

- 7. 09. 98

Applicant's or agent's file reference  
30510/GMlh

REPLY DUE

within 3 month(s)  
from the above date of mailing

International application no.

PCT/EP97/06619

International filing date (day/month/year)

27/11/1997

Priority date (day/month/year)

02/12/1996

International Patent Classification (IPC) or both national classification and IPC

E02D3/12

Applicant

TRANSCENDENTAL MEDITATION FOUNDATION

1. This written opinion is the **first** drawn up by this International Preliminary Examining Authority.

2. This report contains indications relating to the following items:

- I ☒ Basis of the opinion
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

3. The applicant is hereby **invited to reply** to this opinion.

**When?** See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(d).

**How?** By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 66.8 and 66.9.

**Also:** For an additional opportunity to submit amendments, see Rule 66.4.  
For the examiner's obligation to consider amendments and / or arguments, see Rule 66.4bis.  
For an informal communication with the examiner, see Rule 66.6.

**If no reply is filed**, the international preliminary examination report will be established on the basis of this opinion.

4. The final date by which the international preliminary examination report must be established according to Rule 69.2 is: 02/04/1999

Name and mailing address of the international preliminary examining authority



European Patent Office  
D-80298 Munich  
Tel. (+49-89) 2399-0, Tx: 523656 epmu d  
Fax: (+49-89) 2399-4465

Authorized officer / Examiner  
Scharl, W

Formalities officer (incl. extension of time limits)  
Lindquist, P  
Telephone No. (+49-89) 2399-2324



**I. Basis of the opinion**

1. This opinion has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed".*):

**Description, pages:**

1-14 as originally filed

**Claims, No.:**

1-14 as originally filed

**Drawings, sheets:**

1/6-6/6 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

3. This opinion has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

**V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. Statement**

Novelty (N)	Claims
Inventive step (IS)	Claims 1 to 14 NO
Industrial applicability (IA)	Claims

**2. Citations and explanations**

**see separate sheet**

1. The present application does not satisfy the criterion set forth in Article 33(3) PCT because the subject-matter of claim 1 does not involve an inventive step (Rule 65(1) (2) PCT).

Document DE-A-3 332 256 (D1) describes in accordance with the preamble of claim 1 a method for improving the bearing capacity of foundation soils for buildings, wherein an expanding substance is injected in holes provided in the soil.

Moreover, the expansion of the injected substance can be varied and may be very fast with a potential increase in volume of the expanded substance being at least five times the volume of the substance before expansion (7-fache Verschäumungszahl); cf. in particular page 8, paragraphs 2 and 3 of D1.

The subject-matter of claim 1 differs from what is described in D1 only in that the level of the soil and/or building overlying the injection zone is constantly monitored during the injection process.

This, however, is common practice in the field of injecting substances into the ground (see for example EP-A-0 264 998 (D2): page 2, lines 44 to 51, or US-A-4 567 708 (D3): column 3, lines 35 to 37) and it would be an obvious consideration for the skilled man to apply this practice to the method described in document D1.

2. Inasmuch as the features of dependent claims 2 to 14 are not directly known from the documents mentioned in the search report, they obviously concern only minor modifications thereto which come within the customary practice followed by a person skilled in the art of injecting an expanding substance into the ground, and which cannot therefore be regarded as inventive (Article 33(3) PCT).

Consequently, dependent claims 2 to 14 do not appear to contain any additional features which, in combination with the features of any claim to which they refer, involve an inventive step.

3. It is not at present apparent which part of the application could serve as a basis for a new claim which would satisfy the criteria set forth in Article 33(1) PCT. Should the applicant nevertheless regard some particular matter as suitable an independent claim including such particular matter should be filed taking account of Rule 6.3(b) PCT. The applicant should also indicate in the letter of reply the difference of the subject-matter of the new claim vis-à-vis the state of the art and the significance thereof.

The demand must be filed directly with the competent International Preliminary Examining Authority or more Authorities are competent, with the one chosen by the applicant. The first one or two-letter code of that Authority may be indicated by the applicant on the line below:

IPEA/ \_\_\_\_\_

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# PCT

## CHAPTER II

### DEMAND

under Article 31 of the Patent Cooperation Treaty:  
The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty.

For International Preliminary Examining Authority use only

Identification of IPEA		Date of receipt of DEMAND
<b>Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION</b>		Applicant's or agent's file reference <b>30510/GM/lp</b>
International application No. <b>PCT/EP97/06619</b>	International filing date (day/month/year) <b>27 NOVEMBER 1997 (27.11.1997)</b>	(Earliest) Priority date (day/month/year) <b>2 DECEMBER 1996 (2.12.1996)</b>
Title of invention <b>"METHOD FOR INCREASING THE BEARING CAPACITY OF FOUNDATION SOILS FOR BUILDINGS"</b>		
<b>Box No. II APPLICANT(S)</b>		
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) <b>URETEK S.r.l. (for all designated states)</b> <b>Via del Mercato, 12</b> <b>37021 BOSCO CHIESANUOVA</b> <b>ITALY</b>		Telephone No.:
		Facsimile No.:
		Teleprinter No.:
State (i.e. country) of nationality: <b>IT</b>		State (i.e. country) of residence: <b>IT</b>
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) <b>CANTERI Carlo (for U.S.A. only)</b> <b>Piazza Bonacossa, 12</b> <b>22034 BRUNATE</b> <b>ITALY</b>		
State (i.e. country) of nationality: <b>IT</b>		State (i.e. country) of residence: <b>IT</b>
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)		
State (i.e. country) of nationality:		State (i.e. country) of residence:
<input type="checkbox"/> Further applicants are indicated on a continuation sheet.		



**Box No. III AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE**The following person is ☒ agent ☐ common representativeand ☒ has been appointed earlier and represents the applicant(s) also for international preliminary examination.☐ is hereby appointed and any earlier appointment of (an) agent(s)/common representative is hereby revoked.☐ is hereby appointed, specifically for the procedure before the International Preliminary Examining Authority, in addition to the agent(s)/common representative appointed earlier.Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

MODIANO Guido, JOSIF Albert, PISANTY Maurizio, STAUB Gabriella, MODIANO ALAGEM S. Lara, ZANOTTI Nemo, RENIERO C. Silvano - c/o MODIANO & ASSOCIATI - Via Meravigli, 16 - 20123 MILANO - ITALY  
All Italian citizens and professional representatives before the E.P.O.

Telephone No.:

(003902) 86.92.442

Facsimile No.:

(003902) 86.38.60

Teleprinter No.:

☐ Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.**Box No. IV STATEMENT CONCERNING AMENDMENTS**

The applicant wishes the International Preliminary Examining Authority\*

(i) ☒ to start the international preliminary examination on the basis of the international application as originally filed.(ii) ☐ to take into account the amendments under Article 34 of☐ the description (amendments attached).☐ the claims (amendments attached).☐ the drawings (amendments attached).(iii) ☐ to take into account any amendments of the claims under Article 19 filed with the International Bureau (a copy is attached).(iv) ☐ to disregard any amendments of the claims made under Article 19 and to consider them as reversed.(v) ☐ to postpone the start of the international preliminary examination until the expiration of 20 months from the priority date unless that Authority receives a copy of any amendments made under Article 19 or a notice from the applicant that he does not wish to make such amendments (Rule 69.1(d)). *(This check-box may be marked only where the time limit under Article 19 has not yet expired.)*

\* Where no check-box is marked, international preliminary examination will start on the basis of the international application as originally filed or, where a copy of amendments to the claims under Article 19 and/or amendments of the international application under Article 34 are received by the International Preliminary Examining Authority before it has begun to draw up a written opinion or the international preliminary examination report, as so amended.

**Box No. V ELECTION OF STATES**☒ The applicant hereby elects all eligible States *(that is, all States which have been designated and which are bound by Chapter II of the PCT)* except .....*(If the applicant does not wish to elect certain eligible States, the name(s) or country code(s) of those States must be indicated above.)*

**Box No. VI CHECK LIST**

The demand is accompanied by the following documents for the purposes of international preliminary examination:

- |  |   |        |
|--|---|--------|
| 1. amendments under Article 34                     |   |        |
| description  | : | sheets |
| claims   | : | sheets |
| drawings   | : | sheets |
| 2. letter accompanying amendments under Article 34 | : | sheets |
| 3. copy of amendments under Article 19             | : | sheets |
| 4. copy of statement under Article 19              | : | sheets |
| 5. other (specify):                                | : | sheets |

For International Preliminary  
Examining Authority use only

received

not received

☐☐☐☐☐☐☐☐☐☐☐☐☐☐

The demand is also accompanied by the item(s) marked below:

- |  |  |
|--|--|
| 1. <input type="checkbox"/> separate signed power of attorney      | 4. <input checked="" type="checkbox"/> fee calculation sheet           |
| 2. <input type="checkbox"/> copy of general power of attorney      | 5. <input checked="" type="checkbox"/> other (specify): <b>Voucher</b> |
| 3. <input type="checkbox"/> statement explaining lack of signature |  |

**Box No. VII SIGNATURE OF APPLICANT, AGENT OR COMMON REPRESENTATIVE**

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the demand).

Milano, Italy - June 25, 1998

**MODIANO Guido**

For International Preliminary Examining Authority use only

1. Date of actual receipt of DEMAND:

2. Adjusted date of receipt of demand due to CORRECTIONS under Rule 60.1(b):

3. ☐ The date of receipt of the demand is AFTER the expiration of 19 months from the priority date and item 4 or 5, below, does not apply. ☐ The applicant has been informed accordingly.

4. ☐ The date of receipt of the demand is WITHIN the period of 19 months from the priority date as extended by virtue of Rule 80.5.

5. ☐ Although the date of receipt of the demand is after the expiration of 19 months from the priority date, the delay in arrival is EXCUSED pursuant to Rule 82.

For International Bureau use only

Demand received from IPEA on:

## PCT COOPERATION TREATY

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PCT

From the INTERNATIONAL BUREAU

NOTIFICATION OF THE RECORDING  
OF A CHANGE(PCT Rule 92bis.1 and  
Administrative Instructions, Section 422)

To:

MODIANO, Guido  
Modiano & Associati  
Via Meravigli, 16  
I-20123 Milano  
ITALIE

Date of mailing (day/month/year) 02 July 1998 (02.07.98)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference 30510/GM/ch	
International application No. PCT/EP97/06619	International filing date (day/month/year) 27 November 1997 (27.11.97)

1. The following indications appeared on record concerning:		
<input checked="" type="checkbox"/> the applicant	<input type="checkbox"/> the inventor	<input type="checkbox"/> the agent
<input type="checkbox"/> the common representative		
Name and Address URETEK S.R.L. Via del Mercato, 12 I-37021 Bosco Chiesanuova Italy	State of Nationality IT	State of Residence IT
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	
2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:		
<input checked="" type="checkbox"/> the person	<input type="checkbox"/> the name	<input type="checkbox"/> the address
<input type="checkbox"/> the nationality		
<input type="checkbox"/> the residence		
Name and Address LINDGREN, Jimmy Merikatu 1B FIN-00140 Helsinki Finland	State of Nationality FI	State of Residence FI
	Telephone No.	
	Facsimile No.	
	Teleprinter No.	
3. Further observations, if necessary: This International Application has been assigned to LINDGREN, Jimmy with the exception of AT, FR, IT, PT, ES, CH and LI, MC, BA, YU, MK and SI.		
4. A copy of this notification has been sent to:		
<input checked="" type="checkbox"/> the receiving Office	<input checked="" type="checkbox"/> the designated Offices concerned	
<input type="checkbox"/> the International Searching Authority	<input type="checkbox"/> the elected Offices concerned	
<input type="checkbox"/> the International Preliminary Examining Authority	<input type="checkbox"/> other:	

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer S. De Michiel
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.53.38

From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

To:

Modiano, Guido  
MODIANO & ASSOCIATI  
Via Meravigli, 16  
I-20123 Milano  
ITALIE

NOTIFICATION OF RECEIPT  
OF DEMAND

(PCT Rule 61.1(b), first sentence  
and Administrative Instructions, Section 601)

Date of mailing  
(day/month/year)

08.07.98

Applicant's or agent's file reference  
30510/GM/lh

IMPORTANT NOTIFICATION

International application No.  
PCT/EP 97/06619

International filing date (day/month/year)  
27/11/1997

Priority date (day/month/year)  
02/12/1996

Applicant

URETEK S.R.L. et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority considers the following date as the date of receipt of the demand for international preliminary examination of the international application:

29/06/1998

2. This date of receipt is:

- ☒ the actual date of receipt of the demand.  
☐ the date on which the proper corrections to the demand were timely received.

3. ☐ This date is AFTER the expiration of 19 months from the priority date.

**Attention:** The election(s) made in the demand does (do) not have the effect of postponing the commencement of the national phase until 30 months from the priority date (or later in some Offices) (Article 39(1)). Therefore, the acts for entry into the national phase must be performed within 20 months from the priority date (or later in some Offices) (Article 22).

For details, see Annex B to Form PCT/IB/301 sent by the International Bureau and Volume II of the PCT Applicant's Guide.

- ☐ This notification confirms the information given in person or by telephone on:

4. Only where paragraph 3 applies, a copy of this notification has been sent to the International Bureau.

Name and mailing address of the IPEA:



European Patent Office  
D-80298 Munich  
Tel. (+49-89) 2399-0, Tx: 523656 epmu d  
Fax: (+49-89) 2399-4465

Authorized officer

A. Pera

Telephone No.

*[Signature]*

*Demand must be filed directly with the competent International Preliminary Examining Authority or two or more Authorities are competent. In the one chosen by the applicant. The full name or two-letter code of that Authority may be indicated by the applicant on the line below:*

IPEA/

# PCT

## CHAPTER II

### DEMAND

under Article 31 of the Patent Cooperation Treaty:

The undersigned requests that the international application specified below be the subject of international preliminary examination according to the Patent Cooperation Treaty.

For International Preliminary Examining Authority use only

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Identification of IPEA		Date of receipt of DEMAND 28-06-98
<b>Box No. I IDENTIFICATION OF THE INTERNATIONAL APPLICATION</b>		Applicant's or agent's file reference 30510/GM/1p
International application No. PCT/EP97/06619	International filing date (day/month/year) 27 NOVEMBER 1997 (27.11.1997)	(Earliest) Priority date (day/month/year) 2 DECEMBER 1996 (2.12.1996)
Title of invention "METHOD FOR INCREASING THE BEARING CAPACITY OF FOUNDATION SOILS FOR BUILDINGS"		
<b>Box No. II APPLICANT(S)</b>		
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) URETEK S.r.l. (for all designated states) Via del Mercato, 12 37021 BOSCO CHIESANUOVA ITALY		Telephone No.:  Facsimile No.:  Teleprinter No.:
State (i.e. country) of nationality: IT		State (i.e. country) of residence: IT
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) CANTERI Carlo (for U.S.A. only) Piazza Bonacossa, 12 22034 BRUNATE ITALY		
State (i.e. country) of nationality: IT		State (i.e. country) of residence: IT
Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.) LINDGREN, Jimmy MERIKATU 1B FIN-00140 Helsinki		
State (i.e. country) of nationality: FI		State (i.e. country) of residence: FI
<input type="checkbox"/> Further applicants are indicated on a continuation sheet.		

CORRECTED EX OFFICIO BY IPEA  
CORRIGE D'OFFICE PAR L'IPEA  
VON AMTS WEGEN VON DER IPEA BERICHTIGT

## PATENT COOPERATION TREATY

10

PCT

From the INTERNATIONAL BUREAU

NOTIFICATION OF THE RECORDING  
OF A CHANGE(PCT Rule 92bis.1 and  
Administrative Instructions, Section 422)

To:

MODIANO, Guido  
Modiano & Associati  
Via Meravigli, 16  
I-20123 Milano  
ITALIE

Date of mailing (day/month/year)

20 May 1998 (20.05.98)

Applicant's or agent's file reference

30510/GM/ch

## IMPORTANT NOTIFICATION

International application No.

PCT/EP97/06619

International filing date (day/month/year)

27 November 1997 (27.11.97)

1. The following indications appeared on record concerning:



the applicant



the inventor



the agent



the common representative

Name and Address

URETEK S.R.L.  
Piazza della Chiesa, 3  
I-37021 Bosco Chiesanuova  
Italy

State of Nationality

IT

State of Residence

IT

Telephone No.

Facsimile No.

Teleprinter No.

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:



the person



the name



the address



the nationality



the residence

Name and Address

URETEK S.R.L.  
Via del Mercato, 12  
I-37021 Bosco Chiesanuova  
Italy

State of Nationality

IT

State of Residence

IT

Telephone No.

Facsimile No.

Teleprinter No.

3. Further observations, if necessary:

4. A copy of this notification has been sent to:



the receiving Office



the International Searching Authority



the International Preliminary Examining Authority



the designated Offices concerned



the elected Offices concerned



other:

The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

Authorized officer

S. De Michiel

Facsimile No.: (41-22) 740.14.35

Telephone No.: (41-22) 338.83.38

(11)

PCT

From the INTERNATIONAL BUREAU

NOTICE INFORMING THE APPLICANT OF THE  
COMMUNICATION OF THE INTERNATIONAL  
APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:

MODIANO, Guido  
Modiano & Associati  
Via Meravigli, 16  
I-20123 Milano  
ITALIE

Date of mailing (day/month/year) 11 June 1998 (11.06.98)		IMPORTANT NOTICE	
Applicant's or agent's file reference 30510/GM/ch			
International application No. PCT/EP97/06619	International filing date (day/month/year) 27 November 1997 (27.11.97)	Priority date (day/month/year) 02 December 1996 (02.12.96)	
Applicant URETEK S.R.L. et al			

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:  
AU,BR,CA,CN,EP,IL,JP,KP,KR,NO,PL,US

In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:  
AL,AM,AP,AZ,BA,BB,BG,BY,CU,CZ,EA,EE,GE,GH,HU,IS,KE,KG,KZ,LC,LK,LR,LS,LT,LV,MD,MG,  
MK,MN,MW,MX,NZ,OA,RO,RU,SD,SG,SI,SK,SL,TJ,TM,TR,TT,UA,UG,UZ,VN,YU,ZW

The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on  
11 June 1998 (11.06.98) under No. WO 98/24982

**REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)**

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, a demand for international preliminary examination must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

**REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))**

If the applicant wishes to proceed with the international application in the national phase, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. (41-22) 740.14.35	Authorized officer J. Zahra Telephone No. (41-22) 338.83.38
--	---

## PARENT COOPERATION TREATY

(20)

PCT

From the INTERNATIONAL BUREAU

NOTIFICATION OF THE RECORDING  
OF A CHANGE(PCT Rule 92bis.1 and  
Administrative Instructions, Section 422)

To:

MODIANO, Guido  
Modiano & Associati  
Via Meravigli, 16  
I-20123 Milano  
ITALIE

Date of mailing (day/month/year) 16 September 1998 (16.09.98)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference 30510/GM/ch	
International application No. PCT/EP97/06619	International filing date (day/month/year) 27 November 1997 (27.11.97)

## 1. The following indications appeared on record concerning:

☒ the applicant      ☐ the inventor      ☐ the agent      ☐ the common representative

## Name and Address

TRANSCENDENTAL MEDITATION  
FOUNDATION  
Aeulestrasse 38  
9490 Vaduz  
Liechtenstein

## State of Nationality

LI

## State of Residence

LI

## Telephone No.

## Facsimile No.

## Teleprinter No.

## 2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☒ the person      ☒ the name      ☐ the address      ☐ the nationality      ☐ the residence

## Name and Address

PURE LIFE FOUNDATION  
Aeulestrasse 38  
9490 Vaduz  
Liechtenstein

## State of Nationality

LI

## State of Residence

LI

## Telephone No.

## Facsimile No.

## Teleprinter No.

## 3. Further observations, if necessary:

## 4. A copy of this notification has been sent to:

☒ the receiving Office      ☐ the designated Offices concerned  
☐ the International Searching Authority      ☒ the elected Offices concerned  
☒ the International Preliminary Examining Authority      ☐ other:
The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

S. De Michiel

Telephone No.: (41-22) 338.93.38



From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

Modiano, Guido  
MODIANO & ASSOCIATI  
Via Meravigli, 16  
I-20123 Milano  
ITALIE

PCT

NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing  
(day/month/year)

02/12/96

Applicant's or agent's file reference  
30510/GM/lh

IMPORTANT NOTIFICATION

International application No.  
PCT/EP97/06619

International filing date (day/month/year)  
27/11/1997

Priority date (day/month/year)  
02/12/1996

Applicant  
URETEK S.R.L et al

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/



European Patent Office  
D-80298 Munich  
Tel. (+49-89) 2399-0 Tx: 523656 epmu d  
Fax: (+49-89) 2399-4465

Authorized officer

Himmel, U

Tel. (+49-89) 2399-2876



# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 30510/GM/lh	<b>FOR FURTHER ACTION</b>		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/EP97/06619	International filing date (day/month/year) 27/11/1997	Priority date (day/month/year) 02/12/1996	
International Patent Classification (IPC) or national classification and IPC E02D3/12			
Applicant URETEK S.R.L et al			



1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
  
2. This REPORT consists of a total of 5 sheets, including this cover sheet.
 

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 1 sheets.

3. This report contains indications relating to the following items:

- I    ☒ Basis of the report
- II   ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV   ☐ Lack of unity of invention
- V    ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI   ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand  29/06/1998	Date of completion of this report  02. 03. 99
Name and mailing address of the international preliminary examining authority:   European Patent Office D-80298 Munich Tel. (+49-89) 2399-0 Tx: 523656 epmu d Fax: (+49-89) 2399-4465	Authorized officer  Scharl, W  Telephone No. (+49-89) 2399 2489 <div style="text-align: right;">  </div>

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/EP97/06619

**I. Basis of the report**

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

**Description, pages:**

1-14 as originally filed

**Claims, No.:**

1-10 as originally filed

11-14 as received on 07/12/1998 with letter of 03/12/1998

**Drawings, sheets:**

1/6-6/6 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/EP97/06619

---

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes:	Claims	1-14
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-14
Industrial applicability (IA)	Yes:	Claims	1-14
	No:	Claims	

**2. Citations and explanations**

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

---

International application No. PCT/EP97/06619

1. The present application does not satisfy the criterion set forth in Article 33(3) PCT because the subject-matter of claim 1 does not involve an inventive step (Rule 65(1) (2) PCT).

Document DE-A-3 332 256 (D1) describes in accordance with the preamble of claim 1 of the present application a method for improving the bearing capacity of foundation soils for buildings, wherein a substance is injected in holes provided in the soil, said substance expanding as a consequence of a chemical reaction, thus producing compaction of the soil in the vicinity of the injection zone.

Moreover, the degree of expansion of the injected substance can be varied and the rate may be very fast, with a potential increase in volume of the expanded substance being at least five times the original volume (7-fache Verschäumungszahl); cf. in particular page 8, paragraphs 2 and 3 of D1.

Attention is drawn in this respect to the fact that the technical problem to be solved by the invention of document D1 is to provide a method for increasing the bearing capacity of soils which method is suitable for the consolidation of any type of soil; cf. in particular the passage bridging pages 5 and 6 of D1.

Consequently, on pages 8 and 9 of D1 three different embodiments of the invention are described, the first one referring to the above-cited fast expansion of the injected substance in the range of at least five times the volume of the substance before expansion.

The fact that this first embodiment was deleted in the course of the examining procedure of the application on which D1 is based, is of no relevance, since the contents of the original published application which corresponds to D1 (DE-A-3 332 256) was cited in the search report and not the patent specification corresponding to DE-C-3 332 256. From the contents of the original application, however, it is clear that the expansion rate of 2 to 7 cited on page 8 of D1 is not erroneous but rather is in line with the general inventive concept described in D1.

Moreover, the fact that in the method of D1 the injected material is foamed by mixing with the water present in the soil does not provide any technical difference

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

---

International application No. PCT/EP97/06619

with the method claimed in claim 1 of the present application, since the method of claim 1 does not specify the injected substance.

Consequently, the subject-matter of claim 1 differs from what is described in D1 only in that the level of the soil and/or building overlying the injection zone is constantly monitored during the injection process.

This, however, is common practice in the field of injecting substances into the ground (see for example EP-A-0 264 998 (D2): page 2, lines 44 to 51, or US-A-4 567 708 (D3): column 3, lines 35 to 37) and it would be an obvious consideration for the skilled man to apply this practice to the method described in document D1.

Therefore, the subject-matter of claim 1 cannot be regarded as inventive, as it results from an obvious application of common engineering practice to the method described in document D1.

2. Inasmuch as the features of dependent claims 2 to 14 are not directly known from the documents mentioned in the search report, they obviously concern only minor modifications thereto which come within the customary practice followed by a person skilled in the art of injecting an expanding substance into the ground, and which cannot therefore be regarded as inventive (Article 33(3) PCT).

Consequently, dependent claims 2 to 14 do not contain any additional features which, in combination with the features of any claim to which they refer, involve an inventive step.

## PATENT COOPERATION TREATY

16

PCT

From the INTERNATIONAL BUREAU

INFORMATION CONCERNING ELECTED  
OFFICES NOTIFIED OF THEIR ELECTION

(PCT Rule 61.3)

To:

MODIANO, Guido  
Modiano & Associati  
Via Meravigli, 16  
I-20123 Milano  
ITALIE

Date of mailing (day/month/year)

15 July 1998 (15.07.98)

Applicant's or agent's file reference

30510/GM/ch

## IMPORTANT INFORMATION

International application No.

PCT/EP97/06619

International filing date (day/month/year)

27 November 1997 (27.11.97)

Priority date (day/month/year)

02 December 1996 (02.12.96)

Applicant

URETEK S.R.L. et al

1. The applicant is hereby informed that the International Bureau has, according to Article 31(7), notified each of the following Offices of its election:

AP : GH, KE, LS, MW, SD, SZ, UG, ZW

EP : AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE

National : AU, BG, BR, CA, CN, CZ, IL, JP, KP, KR, MN, NO, NZ, PL, RO, RU, SK, US, VN

2. The following Offices have waived the requirement for the notification of their election; the notification will be sent to them by the International Bureau only upon their request:

EA : AM, AZ, BY, KG, KZ, MD, RU, TJ, TM

OA : BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG

National : AL, AM, AZ, BA, BB, BY, CU, EE, GE, GH, HU, IS, KE, KG, KZ, LC, LK, LR, LS, LT, LV,  
MD, MG, MK, MW, MX, SD, SG, SI, SL, TJ, TM, TR, TT, UA, UG, UZ, YU, ZW

3. The applicant is reminded that he must enter the "national phase" before the expiration of 30 months from the priority date before each of the Offices listed above. This must be done by paying the national fee(s) and furnishing, if prescribed, a translation of the international application (Article 39(1)(a)), as well as, where applicable, by furnishing a translation of any annexes of the international preliminary examination report (Article 36(3)(b) and Rule 74.1).

Some offices have fixed time limits expiring later than the above-mentioned time limit. For detailed information about the applicable time limits and the acts to be performed upon entry into the national phase before a particular Office, see Volume II of the PCT Applicant's Guide.

The entry into the European regional phase is postponed until 31 months from the priority date for all States designated for the purposes of obtaining a European patent.

The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer:

C. Cupello

*C. Cupello*

Telephone No. (41-22) 338.83.38

From the RECEIVING OFFICE

**PCT**

To:

Modiano, Guido  
MODIANO & ASSOCIATI  
Via Meravigli, 16  
20123 Milano  
ITALIE

NOTIFICATION OF THE INTERNATIONAL  
APPLICATION NUMBER AND OF THE  
INTERNATIONAL FILING DATE

(PCT Rule 20.5(c))

Date of mailing  
(day/month/year)

13 FEB 1998

Applicant's or agent's file reference  
30510/GM/ch

IMPORTANT NOTIFICATION

International application No.  
PCT/EP 97/06619

International filing date (day/month/year)  
27/11/1997

Priority date (day/month/year)  
02/12/1996

Applicant  
URETEK S.R.L.

Title of the invention

1. The applicant is hereby notified that the international application has been accorded the international application number and the international filing date indicated above.
2. The applicant is further notified that the record copy of the international application was transmitted to the International Bureau on the above date of mailing.
3. ☐ Other:

\* The International Bureau monitors the transmittal of the record copy by the receiving Office and will notify the applicant (with Form PCT/IB/301) of its receipt. Should the record copy not have been received by the expiration of 14 months from the priority date, the International Bureau will notify the applicant (Rule 22.1(c)).

Name and mailing address of the receiving Office



European Patent Office, P.B. 5818 Patentlaan 2  
NL-2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

*M. de Jong-de Koster*

M. de Jong-de Koster



PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

PCT/EP 97 / 06619

International Application No.

International Filing Date

27 NOV 1997

27. 11. 97

EUROPEAN PATENT OFFICE  
PCT INTERNATIONAL APPLICATION

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference

(if desired) (12 characters maximum) 30510/GM/ch

Box No. I TITLE OF INVENTION

METHOD FOR INCREASING THE BEARING CAPACITY OF FOUNDATION SOILS FOR BUILDINGS

Box No. II APPLICANT

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)

URETEK S.r.l.  
Piazza della Chiesa, 3  
37021 BOSCO CHIESANUOVA  
ITALY

☐ This person is also inventor.

Telephone No.

Facsimile No.

Teleprinter No.

State (i.e. country) of nationality:

IT

State (i.e. country) of residence:

IT

This person is applicant for the purposes of:

☐ all designated States

☒ all designated States except the United States of America

☐ the United States of America only

☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (i.e. country) of residence if no State of residence is indicated below.)

CANTERI Carlo  
Piazza Bonacossa, 12  
22034 BRUNATE  
ITALY

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only (If this check-box is marked, do not fill in below.)

State (i.e. country) of nationality:

IT

State (i.e. country) of residence:

IT

This person is applicant for the purposes of:

☐ all designated States

☐ all designated States except the United States of America

☒ the United States of America only

☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE: OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:

☒ agent

☐ common representative

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

MODIANO Guido  
MODIANO & ASSOCIATI  
Via Meravigli, 16  
20123 MILAN - ITALY

Telephone No.

(00392) 86.92.442

Facsimile No.

(00392) 86.38.60

Teleprinter No.

☐ Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

See Notes to the request form

## Box No. VI PRIORITY CLAIM

Further priority claims are indicated in the Supplemental Box ☐

The priority of the following earlier application(s) is hereby claimed:

Country (in which, or for which, the application was filed)	Filing Date (day/month/year)	Application No.	Office of filing (only for regional or international application)
item (1) ITALY	2 December 1996 ( 02.12.1996)	MI96A002520	
item (2)			
item (3)			

Mark the following check-box if the certified copy of the earlier application is to be issued by the Office which for the purposes of the present international application is the receiving Office (a fee may be required):

☐ The receiving Office is hereby requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s):

## Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) (If two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):

ISA /

Earlier search Fill in where a search (international, international-type or other) by the International Searching Authority has already been carried out or requested and the Authority is now requested to base the international search, to the extent possible, on the results of that earlier search. Identify such search or request either by reference to the relevant application (or the translation thereof) or by reference to the search request:

Country (or regional Office):

Date (day/month/year):

Number:

## Box No. VIII CHECK LIST

This international application contains the following number of sheets:

1. request : 3 sheets  
2. description : 14 sheets  
3. claims : 3 sheets  
4. abstract : 1 sheets  
5. drawings : 6 sheets

Total : 27 sheets

This international application is accompanied by the item(s) marked below:

1. ☒ separate signed (2) power of attorney 5. ☐ fee calculation sheet  
2. ☐ copy of general power of attorney 6. ☐ separate indications concerning deposited microorganisms  
3. ☐ statement explaining lack of signature 7. ☐ nucleotide and/or amino acid sequence listing (diskette)  
4. ☐ priority document(s) identified in Box No. VI as item(s) 8. ☐ other (specify):

Figure No. 1 of the drawings (if any) should accompany the abstract when it is published.

## Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Milan, Italy

November 25, 1997



MODIANO Guido

For receiving Office use only

1. Date of actual receipt of the purported international application:	27 NOV 1997	2. Drawings: <input checked="" type="checkbox"/> received: <input type="checkbox"/> not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:		
4. Date of timely receipt of the required corrections under PCT Article 11(2):		
5. International Searching Authority specified by the applicant: ISA /	6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid	

For International Bureau use only

Date of receipt of the record copy  
by the International Bureau:

## PATENT COOPERATION TREATY

⑧

PCT

From the INTERNATIONAL BUREAU

NOTIFICATION CONCERNING  
SUBMISSION OF PRIORITY DOCUMENTS

(PCT Administrative Instructions, Section 411)

To:

MODIANO, Guido  
Modiano & Associati  
Via Meravigli, 16  
I-20123 Milan  
ITALIE

Date of mailing (day/month/year)

19 February 1998 (19.02.98)

Applicant's or agent's file reference

30510/GM/ch

## IMPORTANT NOTIFICATION

International application No.

PCT/EP97/06619

International filing date (day/month/year)

27 November 1997 (27.11.97)

Priority date (day/month/year)

02 December 1996 (02.12.96)

Applicant

URETEK S.R.L. et al

The applicant is hereby notified of the date of receipt by the International Bureau of the priority document(s) relating to the following application(s):

Priority application No.:

MI96A002520

Priority date:

02 Dec 1996 (02.12.96)

Priority country:

IT

Date of receipt of priority document:

16 Feb 1998 (16.02.98)

The International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

S. De Michiel

Telephone No.: (41-22) 338.83.38

**PCT**

From the INTERNATIONAL BUREAU

**NOTIFICATION OF THE RECORDING  
 OF A CHANGE**

(PCT Rule 92bis.1 and  
 Administrative Instructions, Section 422)

To:

MODIANO, Guido  
 Modiano & Associati  
 Via Meravigli, 16  
 I-20123 Milano  
 ITALIE

<b>Date of mailing</b> (day/month/year) 16 September 1998 (16.09.98)	<b>IMPORTANT NOTIFICATION</b>
<b>Applicant's or agent's file reference</b> 30510/GM/ch	
<b>International application No.</b> PCT/EP97/06619	<b>International filing date</b> (day/month/year) 27 November 1997 (27.11.97)

1. The following indications appeared on record concerning:

☒ the applicant      ☐ the inventor      ☐ the agent      ☐ the common representative

<b>Name and Address</b> TRANSCENDENTAL MEDITATION FOUNDATION Aeulestrasse 38 9490 Vaduz Liechtenstein	<b>State of Nationality</b> LI	<b>State of Residence</b> LI
	<b>Telephone No.</b>	
	<b>Facsimile No.</b>	
	<b>Teleprinter No.</b>	

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☒ the person      ☒ the name      ☐ the address      ☐ the nationality      ☐ the residence

<b>Name and Address</b> PURE LIFE FOUNDATION Aeulestrasse 38 9490 Vaduz Liechtenstein	<b>State of Nationality</b> LI	<b>State of Residence</b> LI
	<b>Telephone No.</b>	
	<b>Facsimile No.</b>	
	<b>Teleprinter No.</b>	

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

☒ the receiving Office      ☐ the designated Offices concerned  
☐ the International Searching Authority      ☒ the elected Offices concerned  
☒ the International Preliminary Examining Authority      ☐ other:

<b>The International Bureau of WIPO</b> 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	<b>Authorized officer</b> S. De Michiel Telephone No.: (41-22) 338.83.38
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# PCT

09/308962

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>30510/GM/ch</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/EP 97/06619</b>	International filing date (day/month/year) <b>27/11/1997</b>	(Earliest) Priority Date (day/month/year) <b>02/12/1996</b>
Applicant <b>URETEK S.R.L. et al.</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. ☐ Certain claims were found unsearchable (see Box I).

2. ☐ Unity of invention is lacking (see Box II).

3. ☐ The international application contains disclosure of a **nucleotide and/or amino acid sequence listing** and the international search was carried out on the basis of the sequence listing

☐ filed with the international application.

☐ furnished by the applicant separately from the international application,

☐ but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.

☐ Transcribed by this Authority

4. With regard to the **title**, ☒ the text is approved as submitted by the applicant

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this International Search Report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is:

Figure No. 1 ☒ as suggested by the applicant.

☐ None of the figures.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

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## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 30510/GM/lh	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/EP97/06619	International filing date (day/month/year) 27/11/1997	Priority date (day/month/year) 02/12/1996
International Patent Classification (IPC) or national classification and IPC E02D3/12		
Applicant URETEK S.R.L et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 5 sheets, including this cover sheet.

- ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 1 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 29/06/1998	Date of completion of this report 02.02.99
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. (+49-89) 2399-0 Tx: 523656 epmu d Fax: (+49-89) 2399-4465	Authorized officer Scharl, W Telephone No. (+49-89) 2399 2489 

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/EP97/06619

**I. Basis of the report**

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

**Description, pages:**

1-14 as originally filed

**Claims, No.:**

1-10 as originally filed

11-14 as received on 07/12/1998 with letter of 03/12/1998

**Drawings, sheets:**

1/6-6/6 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/EP97/06619

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Yes:	Claims 1-14
	No:	Claims
Inventive step (IS)	Yes:	Claims
	No:	Claims 1-14
Industrial applicability (IA)	Yes:	Claims 1-14
	No:	Claims

**2. Citations and explanations**

**see separate sheet**

1. The present application does not satisfy the criterion set forth in Article 33(3) PCT because the subject-matter of claim 1 does not involve an inventive step (Rule 65(1) (2) PCT).

Document DE-A-3 332 256 (D1) describes in accordance with the preamble of claim 1 of the present application a method for improving the bearing capacity of foundation soils for buildings, wherein a substance is injected in holes provided in the soil, said substance expanding as a consequence of a chemical reaction, thus producing compaction of the soil in the vicinity of the injection zone.

Moreover, the degree of expansion of the injected substance can be varied and the rate may be very fast, with a potential increase in volume of the expanded substance being at least five times the original volume (7-fache Verschäumungszahl); cf. in particular page 8, paragraphs 2 and 3 of D1.

Attention is drawn in this respect to the fact that the technical problem to be solved by the invention of document D1 is to provide a method for increasing the bearing capacity of soils which method is suitable for the consolidation of any type of soil; cf. in particular the passage bridging pages 5 and 6 of D1.

Consequently, on pages 8 and 9 of D1 three different embodiments of the invention are described, the first one referring to the above-cited fast expansion of the injected substance in the range of at least five times the volume of the substance before expansion.

The fact that this first embodiment was deleted in the course of the examining procedure of the application on which D1 is based, is of no relevance, since the contents of the original published application which corresponds to D1 (DE-A-3 332 256) was cited in the search report and not the patent specification corresponding to DE-C-3 332 256. From the contents of the original application, however, it is clear that the expansion rate of 2 to 7 cited on page 8 of D1 is not erroneous but rather is in line with the general inventive concept described in D1.

Moreover, the fact that in the method of D1 the injected material is foamed by mixing with the water present in the soil does not provide any technical difference

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/EP97/06619

with the method claimed in claim 1 of the present application, since the method of claim 1 does not specify the injected substance.

Consequently, the subject-matter of claim 1 differs from what is described in D1 only in that the level of the soil and/or building overlying the injection zone is constantly monitored during the injection process.

This, however, is common practice in the field of injecting substances into the ground (see for example EP-A-0 264 998 (D2): page 2, lines 44 to 51, or US-A-4 567 708 (D3): column 3, lines 35 to 37) and it would be an obvious consideration for the skilled man to apply this practice to the method described in document D1.

Therefore, the subject-matter of claim 1 cannot be regarded as inventive, as it results from an obvious application of common engineering practice to the method described in document D1.

2. Inasmuch as the features of dependent claims 2 to 14 are not directly known from the documents mentioned in the search report, they obviously concern only minor modifications thereto which come within the customary practice followed by a person skilled in the art of injecting an expanding substance into the ground, and which cannot therefore be regarded as inventive (Article 33(3) PCT).

Consequently, dependent claims 2 to 14 do not contain any additional features which, in combination with the features of any claim to which they refer, involve an inventive step.

1           11. A method according to claim 1, wherein the  
2 injection step comprises several active injection phases  
3 alternated with suitable pauses.

1           12. A method according to one or more of the preceding  
2 claims, wherein the injection substance is heated just  
3 before the injection step.

1           13. A method according to claim 8, wherein the water  
2 content is of 3.44%, by weight.

1           14. A method according to one or more of the preceding  
2 claims, wherein <sup>in</sup>the injection step, tubes (2) are used ✓  
3 through which the expandable substance is injected into the  
4 soil, the tubes having an inner diameter of about 10 mm.

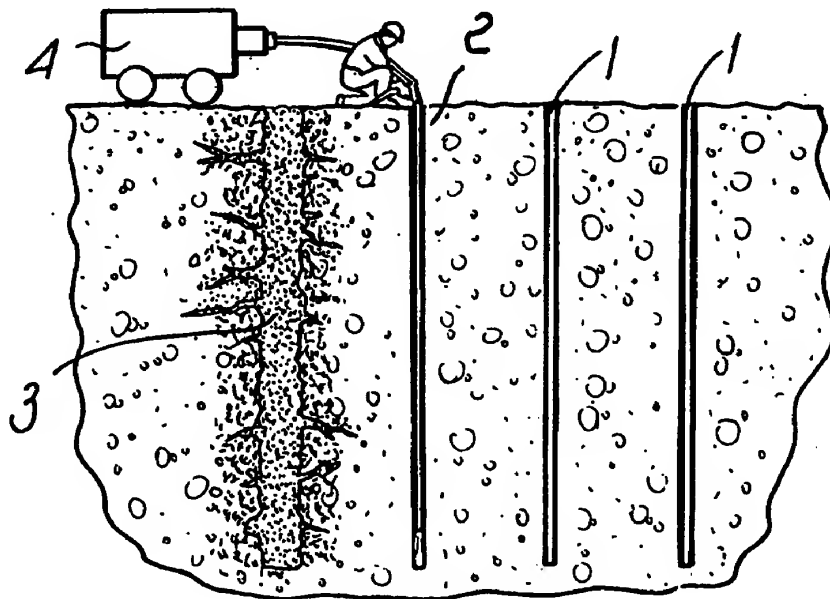
AMENDED SHEET



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b> <b>E02D 3/12</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 98/24982</b> <b>(43) International Publication Date:</b> 11 June 1998 (11.06.98)
<b>(21) International Application Number:</b> PCT/EP97/06619 <b>(22) International Filing Date:</b> 27 November 1997 (27.11.97) <b>(30) Priority Data:</b> M196A002520      2 December 1996 (02.12.96)      IT <b>(71) Applicant (for all designated States except US):</b> URETEK S.R.L. [IT/IT]; Via del Mercato, 12, I-37021 Bosco Chiesanuova (IT). <b>(72) Inventor; and</b> <b>(75) Inventor/Applicant (for US only):</b> CANTERI, Carlo [IT/IT]; Piazza Bonacossa, 12, I-22034 Brunate (IT). <b>(74) Agent:</b> MODIANO, Guido; Modiano & Associati, Via Meravigli, 16, I-20123 Milano (IT).		<b>(81) Designated States:</b> AL, AM, AU, AZ, BA, BB, BG, BR, BY, CA, CN, CU, CZ, EE, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, RO, RU, SD, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.          Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

**(54) Title:** METHOD FOR INCREASING THE BEARING CAPACITY OF FOUNDATION SOILS FOR BUILDINGS

**(57) Abstract**

A method for increasing the bearing capacity of foundation soils for buildings consisting in providing a plurality of holes (1) spaced from each other deep in the soil, and in injecting into the soil, through the holes (1), a substance (3) which expands as a consequence of a chemical reaction, with a potential increase in volume of at least five times the volume of the substance before expansion; the expansion of the substance (3) injected into the soil producing compaction of the contiguous soil.

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METHOD FOR INCREASING THE BEARING CAPACITY OF FOUNDATION  
SOILS FOR BUILDINGS

Technical field

The present invention relates to a method for increasing the bearing capacity of foundation soils for buildings.

Background art

Any building requires the foundation soil to have a  
5 sufficient bearing capacity to support it. Otherwise, the settling of the foundation soil leads to the failure of the overlying building, regardless of whether the settling occurs in the uppermost or in the deep layers.

Before erecting any building, the bearing capacity of  
10 the soil is therefore estimated according to the weight or load which the building will apply to the soil, even using, if necessary, appropriate soil research, such as for example geological and geotechnical research.

In order to ensure the stability of the structure, the  
15 optimum dimensions of the foundations and their rigidity are calculated and the depth of the foundations is also determined, adequately balancing their weight in relation to the bearing capacity of the soil and always maintaining a good safety margin. In case of error, the building may in  
20 fact fail.

Often, however, the bearing capacity of the foundation  
soil is not sufficient, since the soil is compressible, as in the case of filled-in land, non-consolidated land, land with decomposing organic layers, peaty land, swampy land,  
25 land with considerable variations in water content, flooded or washed-out land with voids or with non-uniform or

insufficiently aggregated masses, land with interstitial voids, et cetera; or the building is very heavy and requires a greater bearing capacity than the actual bearing capacity of the foundation soil.

5 Various conventional systems ensure in any case the stability of the building. Generally, these systems tend to directly transfer the weight of the building to the deeper and adequately solid soil layers or to spread the load over a wide ground surface, such as for example the method  
10 consisting in driving piles or micropiles and the like into the foundation soil. This method can be used both before and after construction.

Of course, the driving of piles and micropiles or the like after the construction of the building is extremely  
15 complicated and expensive.

Conventional methods also cope with any subsidence of the building after its construction, such as for example the method described in US patent 4,567,708, which entails the injection of an expandable substance beneath the building to  
20 fill the interstices which have formed and have caused the subsidence and in order to recover the subsidence of the building, or other lifting methods.

In the method disclosed in the above-cited patent, as well as in other lifting systems, however, the foundation  
25 soil is not treated; at the most, one acts on the surface layers of the soil, and therefore if the underlying soil has not settled enough, further subsequent subsidence of said building will occur over time.

A method for ground consolidation using, an expandable  
30 substance, in which the expansion time is controlled to be



slow or very slow, is known from the document DE-A-33 32 256.

#### Disclosure of the invention

A principal aim of the present invention is to solve the above problems by providing a method capable of ensuring the stability of buildings by adequately treating the foundation soil in order to increase its bearing capacity.

Within the scope of this aim, an object of the present invention is to provide a method which does not require the use of cement, concrete, or metal structures driven into the ground, such as piles, micropiles, cement injections, very deep foundations, etcetera.

Another object of the present invention is to provide a method which is simple and easy to perform and can be adopted to increase the bearing capacity of foundation soils both before and after construction of the building.

This aim, these objects, and others which will become apparent hereinafter are achieved by a method for increasing the bearing capacity of foundation soils for buildings, according to the present invention, comprising the steps set forth in claim 1.

#### Brief description of the drawings

Further characteristics and advantages of the present invention will become apparent from the following detailed description of a preferred but not exclusive embodiment of the method according to the invention, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

figure 1 is a schematic view of the injection of the expandable substance through holes formed in the soil;

figures 2 and 3 are views of the result of the expansion of the expandable substance when the substance is injected whilst the tube used for injection is gradually retracted upwards, respectively with pauses at intermediate depth levels or with a continuous motion;

figure 4 is a view of the result of the expansion of the injected substance in the case of sequential injections performed with different tubes, inserted in different holes, in points spaced from each other and at different depths;

figure 5 is a schematic view of an injection operation, according to the invention, with constant monitoring of the sinking recovery of a building foundation;

figures 6-8 are comparative diagrams of dynamic penetrometric tests carried out on a soil area treated according to the invention;

figure 9 is a sectional view of a soil area treated in accordance with the invention.

#### Ways of carrying out the invention

The method according to the present invention substantially consists in forming in the soil a plurality of holes 1 which, if one must act on existing buildings, may or may not pass through the foundation, at different depths and preferably with a distance between two contiguous holes 1 which can vary between 0.5 m and 3 m.

The holes 1 can have variable dimensions according to requirements and can be provided substantially vertically or at an angle with respect to the vertical.

The depth of the holes may also vary according to requirements, as will become apparent hereinafter.

Tubes 2 are then inserted or driven into the holes 1

and a substance 3 expanding as a consequence of a chemical reaction between the components, with a potential volume increase of at least five times the volume of the substance before expansion, is injected into the soil through said tubes. The expression "potential volume increase" relates to the volume increase of the substance as a consequence of an expansion occurring unhindered at atmospheric pressure.

High expansion coefficients of 20-25 times the initial volume or even higher such as 30-33 may be preferred.

The expandable substance is conveniently constituted by a mixture of expandable polyurethane foam, preferably a closed-cell polyurethane foam. This substance can be constituted, for example, by a two-part foam mixed inside a mixing unit 4 connected to the injection tubes 2. The first component can be a mixture of polyols comprising a polyether polyol and/or a polyester polyol, a catalyst, such as RESINOL AL 643 produced by the Dutch company Resina Chemie, and water. The water in the composition may be 3.44% by weight. The second component can be an isocyanate MDI, such as URESTYL 10 manufactured by the same company. The mixing of these two components produces an expandable polyurethane foam the density whereof, at the end of expansion, varies according to the resistance opposed by the soil adjacent to the injection region.

The mixture may expand up to about 33 times its initial volume and the reaction time is of about 3-6 seconds, as it appears from the technical specifications of the manufacturer.

It is of course also possible to use other expandable substances having similar properties without thereby

abandoning the scope of the protection of the present invention.

According to requirements, the expandable substance can be injected through the holes 1 formed beforehand in the soil in a single injection step, as shown in figures 1, 2, and 3, starting from the bottom, whilst the injection tube is gradually retracted upwards, optionally with intermediate pauses, as shown in figure 2, so as to obtain different columns of hardened and expanded substance, or the substance can be injected, optionally by performing sequential injections at fixed and different depths in points which are three-dimensionally and uniformly spaced from each other so as to obtain regions of expanded and hardened substance within the foundation soil, as shown in particular in figure 4, according to requirements and according to the geological characteristics of the soil. In this last case, the tubes used for injection are left in the soil.

Once the substance 3 has been injected, since it has also penetrated in any voids and fractures of the soil thanks to its fluidity, expanding with great force and speed in all directions, it generates a force which compacts and compresses the soil all around, eliminating by compression or filling all voids and microvoids, even extremely small ones, expelling most of the water impregnating the soil, possibly agglomerating loose parts (granules and noncohesive parts) until a mass of soil is obtained which, throughout the treated layer, can no longer be compressed in relation to the weight that it has or will have to bear.

It should be noted that the expandable substance injected at different depths, in appropriately calculated

points having a specific distance from each other, or along ascending lines, during expansion automatically flows towards the more compressible points, which as such offer less resistance to the expandable substance. In this manner, 5 the regions which most need treating are automatically treated more intensely, without leaving spaces with untreated regions.

The immediate nature of the expansion of the injected substance also allows to delimit the expansion region rather 10 precisely, thus allowing to localize very well, in the intended points, the effect to be produced. The intense pressure applied by the injected substance to the surrounding soil is in fact due to the expansion caused by the chemical reaction and is not caused by hydraulic 15 pressure. The expandable substance is injected through a hydraulic pressure which, however, only has the purpose of introducing the substance in the chosen points.

The immediate reaction of the injected substance, in terms of expansion and curing, prevents its migration to 20 faraway areas, where a slow reacting substance may instead arrive. In fact, the slower the expansion reaction is the farther the substance arrives, to the detriment of the precise delimitation of the expansion effect and with consequent increase of the injection substance consumption.

25 Advantageously, since in the conditions of the invention the consolidation has a focused effect with low substance consumption, injection tubes may be used providing sufficient injection substance flow rates which have an inner diameter, for example of 10 mm, thus being easily 30 insertable into and retractable from the soil. Tube

diameters being smaller or larger by some millimeters are also usable. Anyway employing tubes with much larger diameters, of about 2 cm or more, difficult to drive into the soil, for obtaining high substance flow rates is not  
5 necessary.

To efficiently localize the effect of the consolidation, the injection may be carried out, with intermediate pauses. For example injection periods of 15 seconds may be alternated with pauses of 1-2 seconds or even  
10 longer. The durations of the active injection and respectively of the alternating pause periods are in fact selectable to be the more suitable considering factors such as the injection depth, the injection substance composition the length and the cross section of the injection tubes.

15 For obtaining a more rapid expansion reaction of the injected substance without having to switch to other compositions, where necessary, it is possible to raise by heating the temperature of the substance just before the injection operation.

20 As regards the hole depth, two different methods can be performed.

A first method consists in treating the entire thickness of the soil layers which are compressible or have a low bearing capacity, so as to perform consolidation up to  
25 the solid horizon of the layers having a sufficient bearing capacity, regardless of their depth. The solid horizon can be detected by means of geotechnical research conducted on the soil.

The second method instead consists in treating a layer  
30 of soil which, for reasons related to technical and/or

economic convenience, does not reach down to the identified solid horizon, which might be located at an excessive depth, but is in any case thick enough to distribute the overlying weight over a wider surface. The layer of soil treated with the method according to the invention, by constituting a sufficiently compact, solid, and in any case light layer, can be effectively and broadly supported by the underlying layers of soil, even if those layers would not otherwise have a sufficient bearing capacity.

Until now, injection depth of up to 6 m have been successfully experimented, but with adapted tube cross-sections and accurately controlled substance injection flow rates, greater injection depths may be attained.

The expansion of the injected substance following the chemical reaction of its components is very fast and develops a very high expansion force: up to 40 tons per square meter or even higher.

During injection, the level of the overlying building or of the surface soil can be constantly monitored by means of a laser level or another system (see figure 5). When the apparatus 5 indicates that the building or the soil surface begins to rise, this generally means that the compaction of the soil, in three dimensions all around the injection point, has reached very high levels which are generally higher than the required minimum values.

Through the constant monitoring operation, the precise moment when the soil begins rising at a precise spot, due to the narrowly focused expansion force, and further the exact amount of the lifting are accurately detected and may be controlled in real time.

The mass of injected substance, by reacting chemically, in fact expands with great force in all directions, and when the apparatus detects even a small rise at the surface, this means that the expandable substance has encountered less  
5 resistance in expanding in the vertical direction with respect to all other directions and that therefore the soil lying below and around the injected substance withstands and "rejects" all the weight (which is dynamic and therefore multiplied) not only of the entire mass of soil (and of any  
10 building) which rests statically thereon, but also of all the surrounding mass displaced (by friction and cohesion) at a load diffusion angle which is usually calculated at around  $30^{\circ}$  and is simply inverted. The raised soil, too, undergoes compression.

15 By repeating this operation at different depth levels (spaced by approximately 1 meter from each other, but variably according to the kind of soil and to the bearing capacity to be obtained), at each level, a greater bearing capacity is obtained than the required one. By acting in  
20 this last manner and by performing continuous injections along rising columns, wherein tree-like shapes are formed with a very irregular configuration, with protrusions, bumps, and projections even of considerable size produced by the different resistance of the soil to compaction and to  
25 the possible presence of interstices or fractures in the soil, in any case the entire mass and the treated layer of soil are compressed, packed and compacted; the water content decreases considerably; and the soil becomes a valid foundation soil adapted to stably support the building which  
30 lies above or is to be built.



The expandable substance can have a density varying indeed according to the resistance opposed by the surrounding soil to its expansion. In most cases, density can vary between  $100 \text{ kg/m}^3$  and  $300 \text{ kg/m}^3$ . There may also be  
5 higher densities, since the density of the expanded substance is directly proportional to the resistance which it encounters to its expansion. The compression resistance of the expanded substance itself is a function of density.

A substance with a density of  $100 \text{ kg/m}^3$  offers a  
10 resistance of approximately  $14 \text{ kg/cm}^2$ , whilst at a density of  $300 \text{ kg/m}^3$  compression resistance is approximately  $40 \text{ kg/cm}^2$ . These values are far higher than those normally required for a foundation soil. In any case, where higher compression resistance values are required, even at  
15 different depths of the same soil, there is also a greater weight and therefore a higher resistance to expansion; accordingly, a denser and therefore stronger material forms automatically.

In any case, it is possible to momentarily add weight  
20 to a soil surface or to a building.

In practice, the injected and hardened expanded substance does not support the overlying building on its own, though helping to achieve this purpose; the weight of the building is effectively supported by the foundation soil  
25 treated with the method according to the invention.

In practice it has been observed that the method according to the invention fully achieves the intended aim and objects, since it allows, in a very simple, rapid, effective, and final manner, to increase the bearing  
30 capacity of foundation soils until they fully comply with

construction requirements.

Typically, in what seems to be a general trend in ground consolidation techniques, see for example the document DE-A-33 32 256, a very rapid expansion, with very  
5 high expansion coefficients, creating rapidly increasing pressures in the treated soil, is purposely avoided, since it was shown to provoke unwanted, mainly vertical, fissures in the treated mass ground.

In the conditions of the invention, however, it has  
10 surprisingly been noted that fissures occurring between soil masses, not only do not affect the soil compaction, but can in fact be advantageously exploited.

Technical tests and studies, carried out on built lots where the consolidation method of the invention has been  
15 used, have demonstrated that the expansion of the injected material occurs first in directions where the soil offers less resistance, but only for a limited extent. In the case of a built spot this happens, in the first place, laterally to the foundation and not in the vertical direction, where  
20 the weight of the building acts.

Only after the ground compaction degree is such as to provide a resistance to the lateral expansion forces well exceeding the weight force exerted by the building, a vertical force is obtained such as to raise the foundation  
25 and the building. In fact it is not only the weight of the building which has to be compensated for, but also other resistant forces, such as part of the weight of adjacent constructions, lateral friction forces and the flexural strength of the built structure itself.

30 While an immediate reaction of the injected material,

in terms of expansion and solidification, may provoke indeed fissures between soil masses forced to move with respect to each other by rapidly increasing, strong forces, a certain quantity of the injected substance appears in fact to fill  
5 up the fissures so as to "weld" satisfactory the soil masses, at least in the area to be consolidated, which is immediately close to the injection site and under the foundation of the built structure. For exemplification see figure 9, where a "welded" fissure may clearly be seen.

10 Penetrometric tests, the results whereof are shown in the diagrams of figures 6-8, have been carried out both under built spots treated with the consolidation method according to the invention, after a soil lifting has been sensed by the level apparatus, and laterally thereto, in  
15 close vicinity, at about 20 cm from the foundation.

From these diagrams showing comparatively the soil bearing capacity before consolidation (the not shadowed prisms) and after the consolidation (the shadowed prisms), clearly appears that the main consolidation occurs under the  
20 foundation, between 120 and about 300 cm of depth (figure 6), while at only 20 cm laterally from the foundation, the consolidation appears, at the same depths as before, significantly diminished (figure 7).

It is believed that this clearly shows the focused  
25 effect of the consolidation carried out according to the invention which practically provides a noteworthy reinforcement of mainly the soil under the foundations.

The diagram of figure 8, drawn in the condition where an amount of expandable substance has been injected which  
30 has not provoked any detectable lifting reaction of the

soil under the building foundation, shows that in fact, laterally, at only 20 cm from the foundation, practically no effective soil compaction has occurred which would have allowed generation of the vertical force necessary to the  
5 lifting and thereby also limiting the area where fissures may occur.

The method according to the invention has successfully been applied to consolidate the ground and to compensate subsidences under heavily loaded foundations in airports, in  
10 industrial and commercial constructions as well as under very old, historic buildings and at archaeological sites.

Checkings of treated sites have been made recently, and have all given satisfactory results. The inspections have been carried out in accordance with a procedure  
15 approved by the French Control Institute SOCOTEC consisting substantially in injecting, at a site selected by an inspector in a treated zone, at random, a small quantity of the injection substance (about 20% of the quantity initially injected). The result has been considered positive if the  
20 injection triggered at least a minimum lifting effect of the soil surface.

The method thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept; all the details may  
25 furthermore be replaced with other technically equivalent elements.

CLAIMS

1           1. A method for increasing the bearing capacity of  
2 foundation soils for buildings comprising: providing a  
3 plurality of holes (1) spaced from each other deep in the  
4 soil; injecting into the soil, through said holes, a  
5 substance (3) which expands as a consequence of a chemical  
6 reaction; producing compaction of the soil contiguous to  
7 the injection zone due to the expansion of said substance  
8 injected into the soil, characterized in that it further  
9 comprises the step of constantly monitoring the level of the  
10 soil and/or building overlying the injection zone to detect  
11 the moment when the building and/or the soil surface,  
12 overlying said injection zone, begins to raise which is the  
13 moment in which the compaction of the soil has reached  
14 levels generally higher than the required minimum value, and  
15 in that the expansion of the injected substance is very fast  
16 with a potential increase in volume of the expanded  
17 substance being at least five times the volume of the  
18 substance before expansion.

1           2. A method according to claim 1, characterized in that  
2 the injecting step is repeated at different depth levels for  
3 producing compaction of the masses or layers of treated  
4 soil.

1           3. A method according to claim 2, characterized in that  
2 said different depth levels are spaced by approximately 1 m  
3 from each other, at each level a greater bearing capacity  
4 than the required one being obtainable.

1           4. A method according to any of the preceding claims,  
2 characterized in that said monitoring step is performed with

3 a laser level apparatus (5).

1 5. A method according to any of the preceding claims,  
2 characterized in that said holes (1) are provided  
3 vertically, the injection steps being performed continuously  
4 along rising columns wherein tree-like shapes are formed  
5 with a very irregular configuration with protrusions, bumps  
6 and projections of considerable size produced by different  
7 resistance to compaction of the soil, and by the presence  
8 of interstices or fractures in the soil.

1 6. A method according to any of the preceding claims,  
2 wherein the entire thickness of the soil layers which are  
3 compressible or have low bearing capacity is treated so as  
4 to perform consolidation up to the solid horizon of the  
5 layers having a sufficient bearing capacity regardless of  
6 the depth at which the solid horizon is located.

1 7. A method according to any of the preceding claims,  
2 wherein the expandable substance is selected from substances  
3 adapted to produce immediate expansion, such as a substance  
4 comprising a mixture of polyols and an isocyanate MDI.

1 8. A method according to claim 7, wherein the  
2 expandable substance comprises a mixture of two components,  
3 the first being a polyether polyol and/or a polyester  
4 polyol, a catalyst and water, and the second being the  
5 isocyanate MDI.

1 9. A method according to any of the above claims,  
2 characterized in that the distance between two adjacent  
3 holes is between 0.5 m and 3 m.

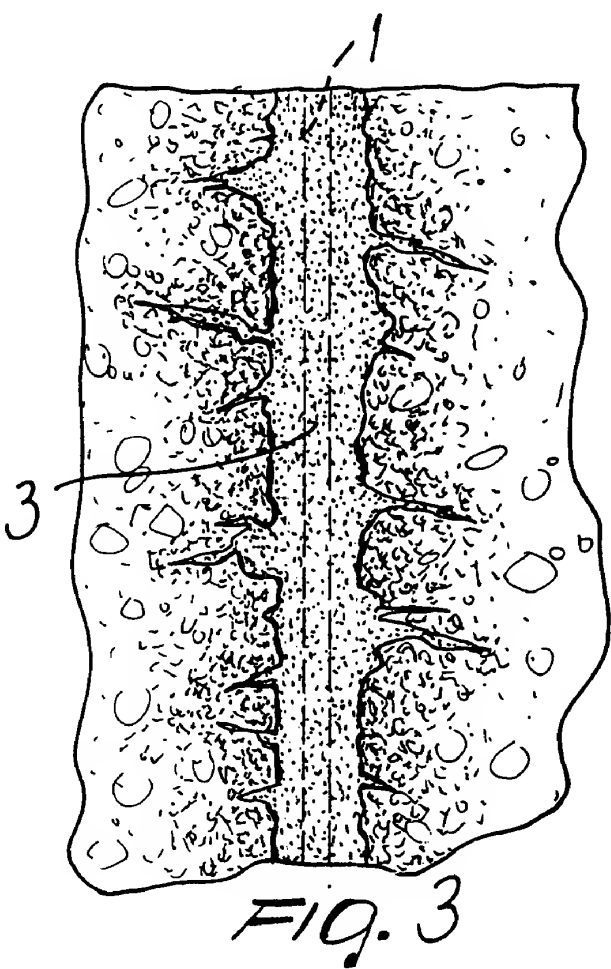
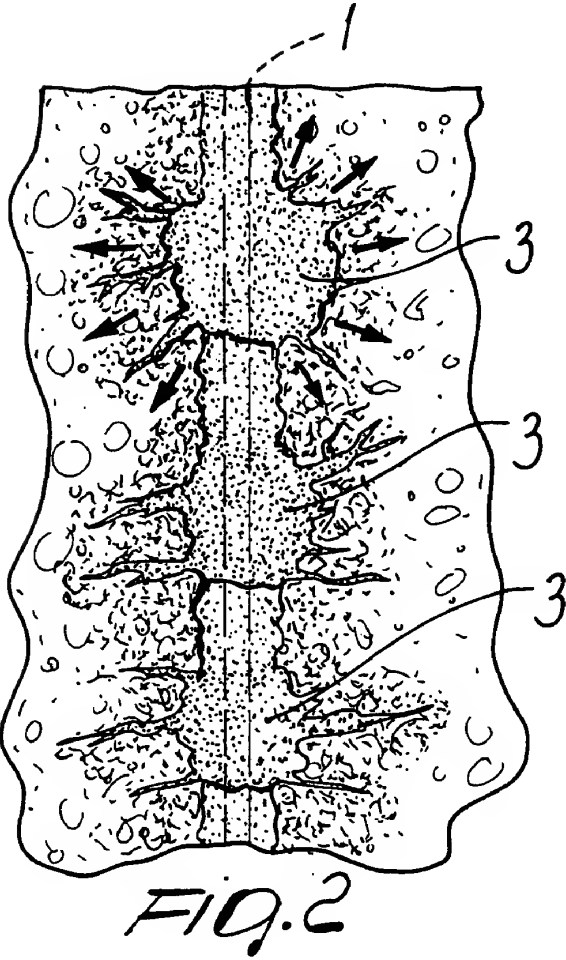
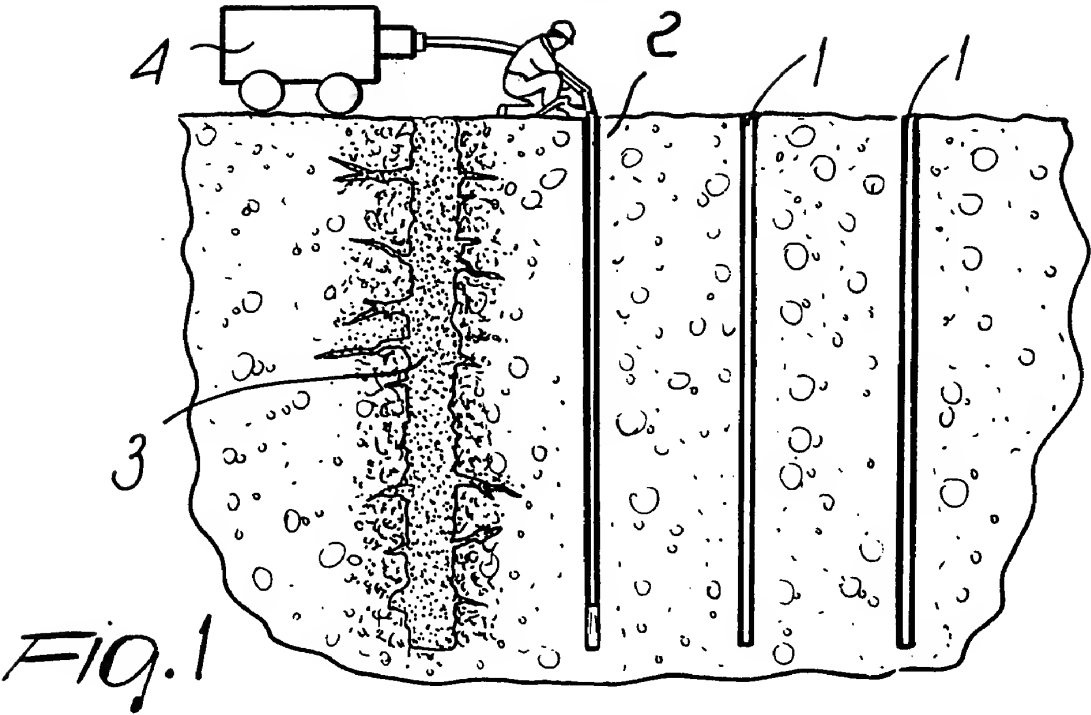
1 10. A method according to any of the claims 1-4 and 6-  
2 9, characterized in that said holes (1) are provided at an  
3 angle with respect to the vertical.

1           11. A method according to claim 1, wherein the  
2 injection step comprises several active injection phases  
3 alternated with suitable pauses.

1           12. A method according to one or more of the preceding  
2 claims, wherein the injection substance is heated just  
3 before the injection step.

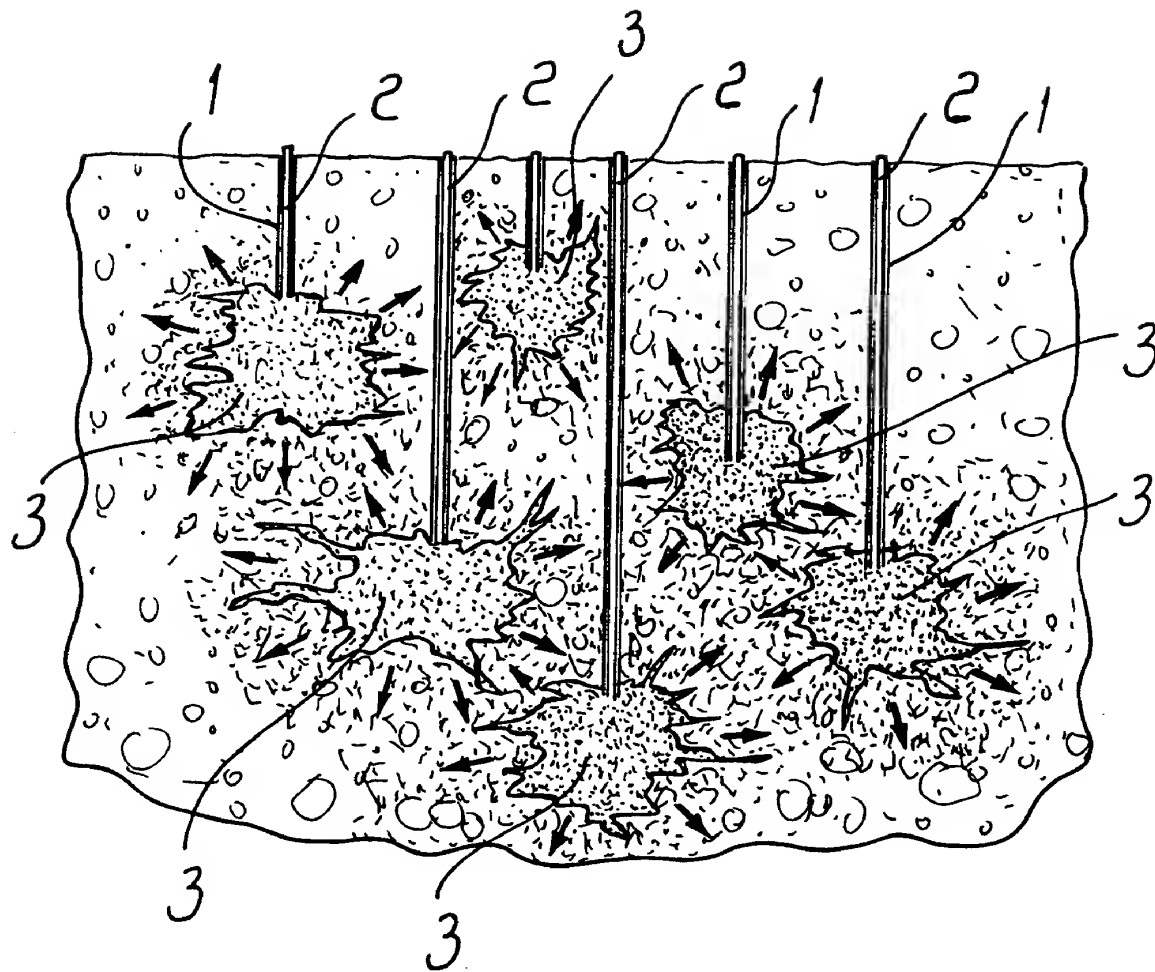
1           13. A method according to claim 8, wherein the water  
2 content is of 3.44%, by weight.

1           14. A method according to one or more of the preceding  
2 claims, wherein the injection step, tubes (2) are used  
3 through which the expandable substance is injected into the  
4 soil, the tubes having an inner diameter of about 10 mm.

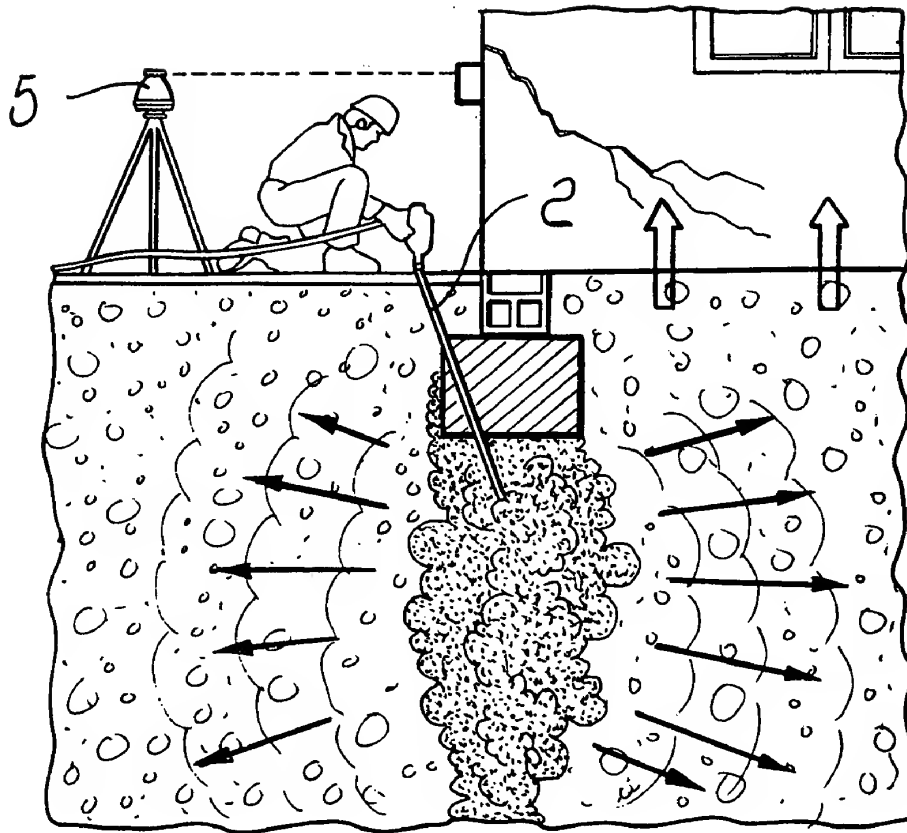




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*Fig. 4*

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*Fig. 5**Fig. 9*

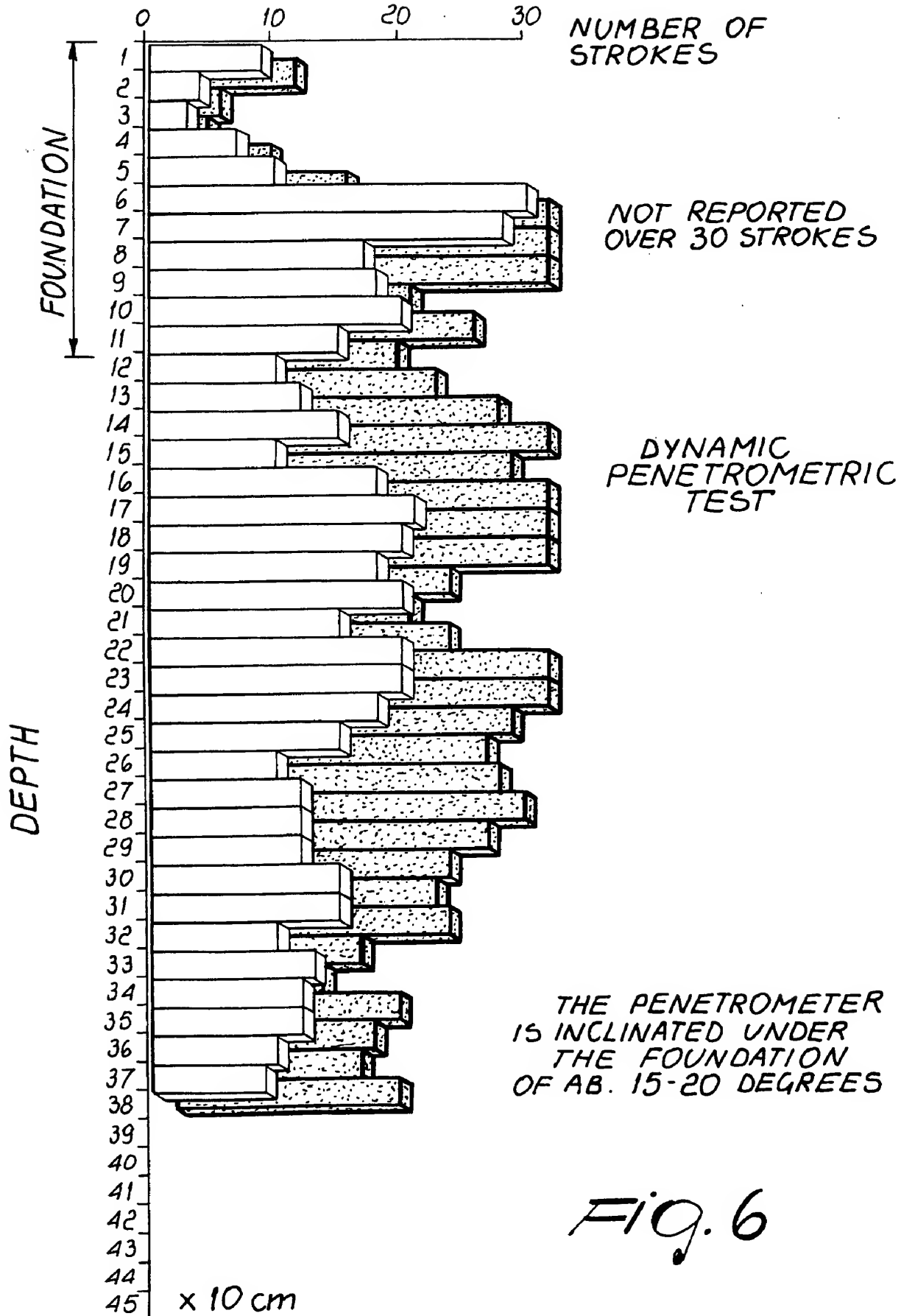
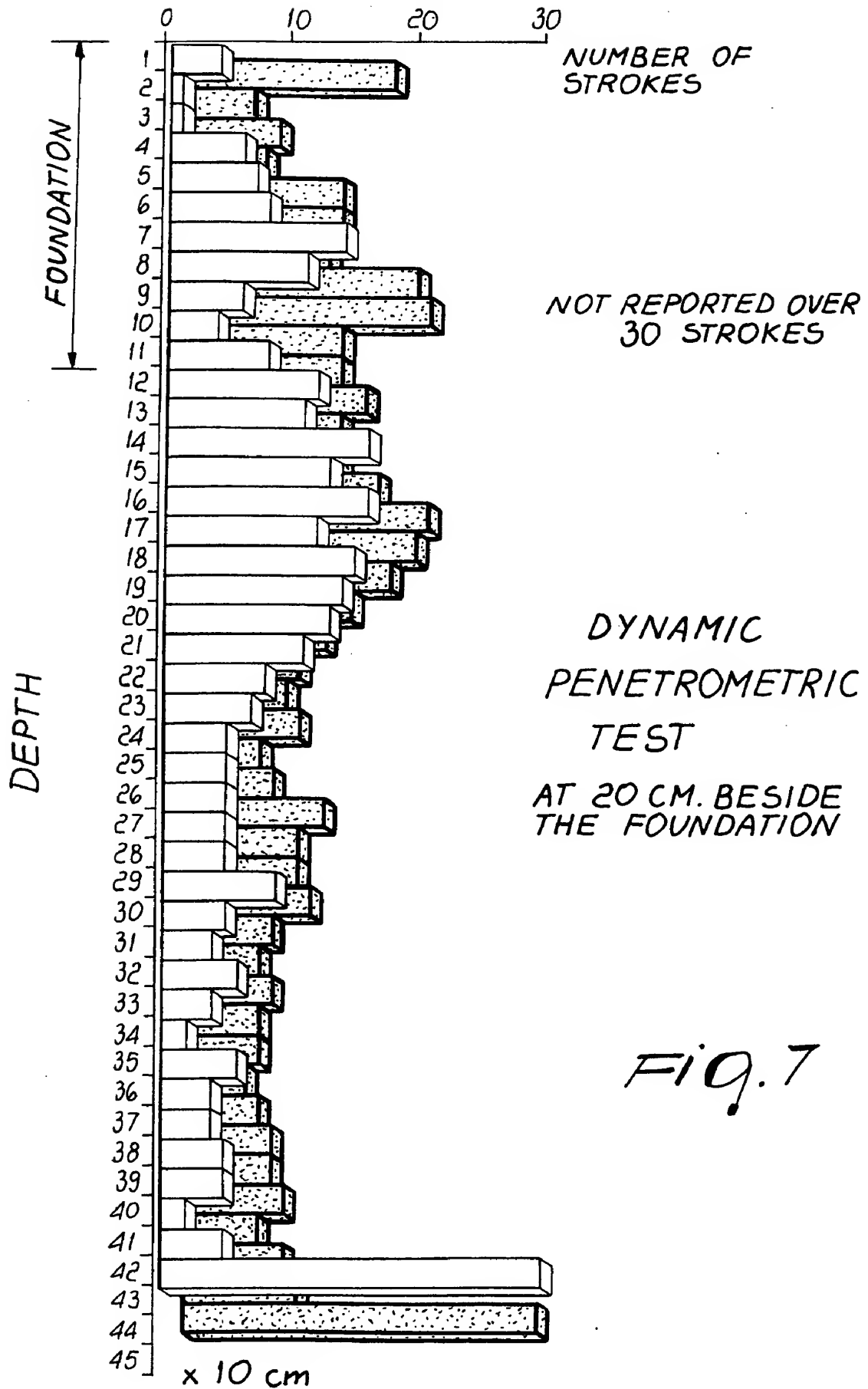


Fig. 6

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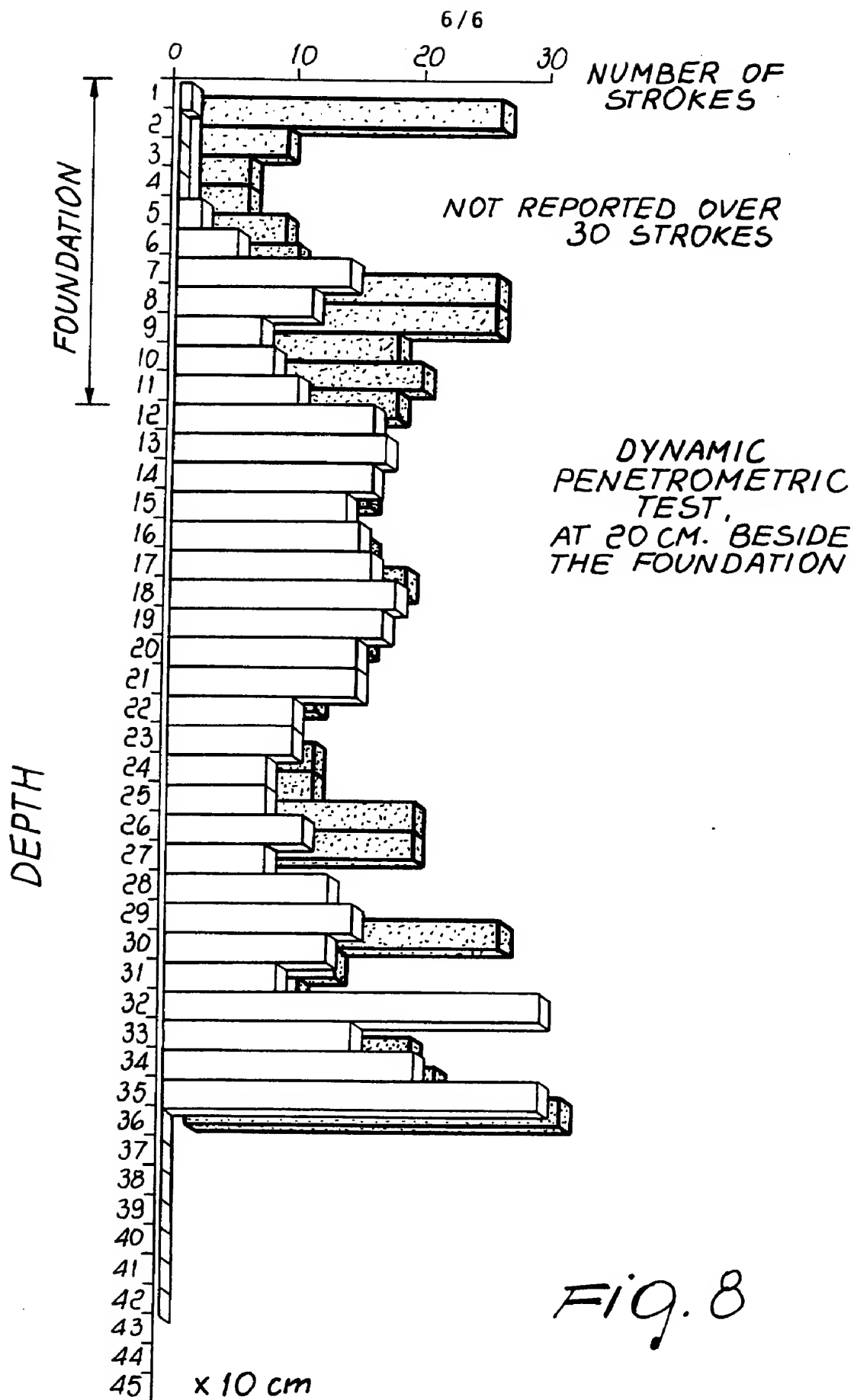


Fig. 8

# INTERNATIONAL SEARCH REPORT

Inter. Application No

PCT/EP 97/06619

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 6 E02D3/12

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 E02D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 878 686 A (HAGEMAN JOHN A ET AL) 22 April 1975	1-4,8
Y	see the whole document	5,7
Y	DE 33 32 256 A (MUELLER BAUCHEMIE) 6 September 1984	7
A	cited in the application see page 12, line 1 - page 13, line 6; figures 1-3	1-6,8
Y	EP 0 264 998 A (BALLAST NEDAM GROEP NV) 27 April 1988	5
A	see page 1, line 44 - page 3, line 52; figures 1-10	1-4,6-8
A	US 4 744 700 A (ANDY ALBERT ET AL) 17 May 1988 see column 1, line 55 - column 5, line 34	1-3
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Date of the actual completion of the international search

26 March 1998

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02/04/1998

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European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

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A	US 4 567 708 A (HAEKKINEN VEIKKO) 4 February 1986 cited in the application see the whole document ----	1,13,14
A	US 5 306 104 A (WITHERSPOON W TOM) 26 April 1994 see the whole document ----	11,13
A	US 5 401 121 A (NAKASHIMA ET AL.) 28 March 1995 see column 4, line 39 - column 10, line 3; figures 1-13 -----	1,11-13

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		DE 4329208 A	05-01-95
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